Example final project solution

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This is a Live script of our example solution for the final project. As there are many ways to perform the tasks for this project, your own solution will likely be different. Feel free to compare your own methods and results with our own.

Section 1: Enhancing the video

Enhance the video by removing the noise, convert the video to grayscale, then save the result as a new video file.

For an example frame, go from the noisy image (left) to the grayscale image (right).

Initialize the video reader and writer objects.

```
vid = VideoReader("RoadTraffic.mp4");
vidWr = VideoWriter("RoadTrafficFiltered","MPEG-4");
vidWr.FrameRate = vid.FrameRate;
open(vidWr);
```

Loop through every frame, apply the filter, convert to grayscale, and write the result to a new video.

```
while hasFrame(vid)
    % Read a frame
    frame = readFrame(vid);

    % Remove noise using a 2D median filter
    frame(:,:,1) = medfilt2(frame(:,:,1));
    frame(:,:,2) = medfilt2(frame(:,:,2));
    frame(:,:,3) = medfilt2(frame(:,:,3));

    % Convert to grayscale
    frame = im2gray(frame);
```

```
    % Write frame to new video
    writeVideo(vidWr,frame);
end
close(vidWr);
```

Section 2.1: Isolating the cars with background subtraction

Isolate the cars using background subtraction.

The end goal of section 2 for an example frame, is to go from the grayscale image (left) to the BW mask image (right).


This is done using background subtraction to first isolate the moving cars from the stationary background.

Background subtraction preparation

First, create a background image with no cars from the first frame.

```
vid = VideoReader("RoadTrafficFiltered.mp4");
backImg = readFrame(vid);
backImg = im2gray(backImg);
backImg = im2double(backImg);
```

Sections 2.2 & 3: Segmenting cars and Calculating region properties

Segment the cars and create a table that contains a row for each frame of the video and a column for the following three properties: number of regions, mean region size, and total region size.

Initialize the video reader object.

```
vid = VideoReader("RoadTrafficFiltered.mp4");
```

Initialize the table variables.

```
NumberRegions = [];
MeanRegionSize = [];
TotalRegionSize = [];
```

Loop through every frame and collect region properties.

```
while hasFrame(vid)
    % Read a frame
    frame = readFrame(vid);
    frame = im2gray(frame);
    frame = im2double(frame);

    % Perform background subtraction
    subImg = abs(frame - backImg);

    % Segment cars from subtraction result
    mask = segmentCars(subImg);

    % Filter out small regions
    mask = bwpropfilt(mask,'Area',[4000 inf]);

    % Collect region properties
    props = regionprops("table", mask, "Area");
    numReg = height(props);
    meanRegS = mean(props.Area);
    totRegS = sum(props.Area);

    % Append results to arrays
    NumberRegions = [NumberRegions; numReg];
    MeanRegionSize = [MeanRegionSize; meanRegS];
    TotalRegionSize = [TotalRegionSize; totRegS];
end
```

Convert arrays to a table variable.

```
carData = table(NumberRegions, MeanRegionSize, TotalRegionSize)
```

carData = 240×3 table

	NumberRegions	MeanRegionSize	TotalRegionSize
1	0	NaN	0
2	0	NaN	0
3	0	NaN	0
4	0	NaN	0
5	0	NaN	0
6	1	6277	6277
7	2	14378	28756
8	2	1.9762e+04	39523
9	2	1.8682e+04	37365
10	2	17997	35994
11	2	1.8166e+04	36333
12	2	17993	35986
13	2	17383	34766

	NumberRegions	MeanRegionSize	TotalRegionSize
14	2	16644	33288
15	2	1.6402e+04	32805
16	3	1.5725e+04	47176
17	3	1.9769e+04	59308
18	2	24630	49260
19	2	22867	45734
20	2	1.8030e+04	36059
21	1	27163	27163
22	1	26315	26315
23	1	25080	25080
24	1	23729	23729
25	1	21947	21947
26	1	16165	16165
27	1	7417	7417
28	0	NaN	0
29	0	NaN	0
30	0	NaN	0
31	0	NaN	0
32	0	NaN	0
33	0	NaN	0
34	0	NaN	0
35	0	NaN	0
36	0	NaN	0
37	0	NaN	0
38	0	NaN	0
39	0	NaN	0
40	0	NaN	0
41	0	NaN	0
42	0	NaN	0
43	0	NaN	0
44	0	NaN	0
45	0	NaN	0
46	0	NaN	0

	NumberRegions	MeanRegionSize	TotalRegionSize
47	0	NaN	0
48	0	NaN	0
49	0	NaN	0
50	0	NaN	0
51	0	NaN	0
52	0	NaN	0
53	0	NaN	0
54	0	NaN	0
55	0	NaN	0
56	0	NaN	0
57	0	NaN	0
58	0	NaN	0
59	0	NaN	0
60	0	NaN	0
61	0	NaN	0
62	1	7930	7930
63	1	8557	8557
64	1	9166	9166
65	1	9498	9498
66	1	9880	9880
67	1	10215	10215
68	1	10155	10155
69	1	10635	10635
70	1	11282	11282
71	1	12326	12326
72	1	7925	7925
73	0	NaN	0
74	1	12756	12756
75	1	26270	26270
76	1	24131	24131
77	1	22916	22916
78	1	21659	21659
79	1	20915	20915

	NumberRegions	MeanRegionSize	TotalRegionSize
80	1	19832	19832
81	1	18888	18888
82	1	17945	17945
83	1	17013	17013
84	1	13610	13610
85	1	5781	5781
86	0	NaN	0
87	0	NaN	0
88	0	NaN	0
89	0	NaN	0
90	0	NaN	0
91	0	NaN	0
92	0	NaN	0
93	0	NaN	0
94	1	13005	13005
95	1	25068	25068
96	1	23649	23649
97	1	22061	22061
98	1	20898	20898
99	1	20167	20167
100	1	19213	19213

⋮

Segmentation function

```
function [BW,maskedImage] = segmentCars(X)
%segmentCars Segment image using auto-generated code from imageSegmenter app
%  [BW,MASKEDIMAGE] = segmentCars(X) segments image X using auto-generated
%  code from the imageSegmenter app. The final segmentation is returned in
%  BW, and a masked image is returned in MASKEDIMAGE.

% Auto-generated by imageSegmenter app on 17-Jun-2021
%----------------------------------------------------
```

```
% Threshold image - manual threshold
BW = X > 0.1;

% Close mask with disk
radius = 3;
decomposition = 0;
se = strel('disk', radius, decomposition);
BW = imclose(BW, se);

% Fill holes
BW = imfill(BW, 'holes');

% Open mask with disk
radius = 5;
decomposition = 0;
se = strel('disk', radius, decomposition);
BW = imopen(BW, se);

% Close mask with rectangle
dimensions = [1 39];
se = strel('rectangle', dimensions);
BW = imclose(BW, se);

% Fill holes
BW = imfill(BW, 'holes');

% Create masked image.
maskedImage = X;
maskedImage(~BW) = 0;
end
```